RECIPROCATING COMPRESSOR MOUNTING
COMMENTS ON ISOLATION SPRING SUPPORT
TECH TRANSFER, INC.
23-DEC-98

UNBALANCED FORCES

In reciprocating compressors, mechanical vibration is generated by unbalanced forces and moments that are produced by two masses: rotating and reciprocating. Rotating masses consist of crankpin, crankpin web, and 2/3 the connecting rod weight. These masses generate forces at one times running speed (1X RPM). Reciprocating masses consist of the pistons, piston rods, crossheads, crosshead pins, and 1/3 the connecting rod weights. These masses generate horizontal forces at 2X RPM.

Also, there are unbalanced forces created by the gas compression in the cylinders. These are composed of cylinder load couples and crosshead support forces. Piping shaking forces due to gas pulsation are always present and acoustical resonance may occur.

Equipment, piping and skid vibration can cause downtime due to failure of structural, piping and instrumentation components.

UNBALANCED ENERGY DISSIPATION

The unbalanced forces present in all reciprocating compressor installations must be correctly dissipated through proper energy paths to prevent vibration problems. These energy paths are created by equipment support, piping support, skid design and skid mounting. If any one of these energy paths is not complete, the energy dissipates locally as vibration.

SKID DESIGN

Two of the most critical aspects of a reciprocating compressor installation with acceptable vibrations levels are: (1) correct skid design and (2) proper skid mounting.

In general, the skid must be stiff enough to transmit unbalanced energy into a support foundation (or structure) and prevent structural excitation. This requires a four-runner design with full depth longitudinal and transverse beams. In addition, equipment pedestals, crosshead supports and discharge bottle (or outboard cylinder) supports must not be flexible. Concrete fill in various skid areas is highly recommended to help dissipate energy.

In most cases, it is not practical to design a skid that is infinitely stiff with enough mass to dissipate all the unbalanced compressor forces. A skid can approach this goal but it is very large, massive and expensive.

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SKID MOUNTING

Much of the skid stiffness is provided by the support structure. Critical support points are at four locations across transverse beams in the following locations: (1) motor or engine feet, (2) compressor feet, (3) scrubber support, (4) cooler support and (5) skid ends. A trampoline effect can result from support of perimeter beams only. The skid should be supported along the two inner runners. **The skid should be welded directly to the deck beams.**

ISOLATION SPRING SUPPORT

Based on field experience, isolation spring supports of reciprocating compressor skids will result in significant vibration problems. Tech Transfer has successfully engineered skids with isolation spring supports up to 1500 BHP for air compressors on seismic boats; however, these machines are mounted down inside the hull and there is no other choice. **In general, isolation spring supports are not recommended for the following reasons:**

- The unbalanced forces cause a rocking motion at the compressor frame. The entire skid will twist from side-to-side in the compressor areas. In extreme cases, compressor frames have been distorted and caused main bearing failures.

- The unbalanced forces have high vertical components that will cause a trampoline effect and high vertical vibration.

- Energy from the unbalanced forces will be dissipated as high vibration on the skid, equipment, piping, scrubbers and instrumentation. This may cause hazardous fatigue problems. Damage to valves and instrumentation will cause high maintenance and excessive down time. The springs do not provide a path for the unbalanced energy to get out of the skid.

- In order to prevent high piping stress and fatigue problems, the inner connecting piping to the skid must be very flexible. If a reciprocating compressor piping system is very flexible, it will develop fatigue problems due to normal pulsation and mechanical excitation. Flexible connectors in pulsating services are not recommended because they fatigue in a short period of time. In one way or another, significant piping vibration problems will occur.

- Isolator springs mounts must be specially constructed to prevent lock-up in an offshore environment due to corrosion, galling or gunk buildup.

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